III. CLAIM AMENDMENTS

1. (Original) A method for arranging communication between terminals (MT1-MT4) and an access point (AP1, AP2) in a communication system (1) applying data transmission frames (FR) which comprise at least uplink timeslots (UL) for performing data transmission from the terminals (MT1-MT4) to the access point (AP1, AP2), and downlink timeslots (DL) for performing data transmission from the access point (AP1, AP2) to the terminals (MT1-MT4) via a wireless communication channel, and in which method the terminals (MT1-MT4) can be allocated one or more timeslots (702-707, 802-807) of said frames, **characterized** in that in at least part of said frames (FR), at least partly simultaneous timeslots (704-707, 802-804) are allocated to at least two terminals (MT1-MT4), wherein in the method, the spatial signature of at least said two terminals (MT1-MT4) is determined, that in the method, measurements are taken to estimate the timing and frequency offsets and the properties of the communication channel, which measurements are taken at least partly on the basis of a signal transmitted by the terminal (MT1) to the access point (AP1, AP2), wherein the results of said measurements are used to select the terminals (MT1-MT4) to which simultaneous timeslots (702-707, 802-807) are to be allocated, and that during said measurements, the other terminals (MT1-MT4) communicating with the access point (AP1, AP2) do not transmit a signal to said access point (AP1, AP2).

2. (Original) The method according to claim 1, **characterized** in that in the method, simultaneous transmission and/or reception for at least two terminals is implemented on the basis of selection of terminals (MT1-MT4) made on the basis of said measurement results.

3. (Previously Presented) The method according to claim 1, **characterized** in that in the data transmission frames (FR), also a random access phase (RA) is used, during which the terminal (MT1-MT4) can perform transmissions to the access point (AP1, AP2), that signals transmitted in said random access phase (RA) are stored at the access point, and that the stored signals are used to determine the spatial signature of the terminal (MT1-MT4).

4. (Previously Presented) The method according to claim 1, **characterized** in that the stored signals are used to determine time and frequency offsets of the terminal (MT1-MT4).

5. (Previously Presented) The method according to claim 1, **characterized** in that said measurements are used to determine the position of the terminal (MT1-MT4).

6. (Previously Presented) The method according to claim 1, **characterized** in that in data transmission from the terminal

(MT1-MT4) to the access point (AP1, AP2), at least the following steps are taken:

a receiving step, in which signals transmitted by a terminal are received with at least two different antennas,

a first correction step, in which the received signals are corrected on the basis of the measured time and frequency offsets,

a first conversion step, in which the corrected signals are subjected to time-to-frequency conversion,

a first channel estimation step, in which the signals converted to the frequency domain are subjected to channel estimation and determination of the spatial signature,

a combination step, in which the signals are combined, and

a decoding step for decoding the combined signal to determine the information transmitted from the terminal (MT1-MT4).

7. (Original) The method according to claim 6, **characterized** in that said combination step is taken before said first correction step.

8. (Previously Presented) The method according to claim 6, **characterized** in that at least said first conversion step is taken substantially simultaneously for signals relating to different terminals.

9. (Previously Presented) The method according to claim 6, **characterized** in that at least said first conversion step is taken consecutively for signals relating to different terminals.

10. (Previously Presented) The method according to claim 6, **characterized** in that after the combination step, also a second channel estimation and correction step is taken, in which properties of the communication channel are estimated on the basis of the combined signal, and the combined signal is corrected on the basis of the estimated properties of the communication channel.

11. (Previously Presented) The method according to claim 6, **characterized** in that said combination step is taken after said second channel estimation and correction step.

12. (Previously Presented) The method according to claim 6, **characterized** in that signals transmitted by at least two different terminals are received at the access point substantially simultaneously, wherein said first correction step,

first conversion step, combination step and decoding step are taken separately for the signal of each terminal.

13. (Previously Presented)The method according to claim 6, **characterized** in that in data transmission from the access point (AP1, AP2) to the terminal (MT1-MT4), at least the following steps are taken:

an encoding step for encoding the signal to be transmitted,

a weighting step, in which at least two transmission signals are formed of the signal to be transmitted,

a second conversion step, in which said at least two transmission signals are subjected to frequency-to-time conversion, and

a transmission step, in which the transmission signals converted to the time domain are transmitted.

14. (Original) The method according to claim 13, **characterized** in that the access point transmits to at least two different terminals (MT1-MT4) substantially simultaneously, wherein said encoding step and weighting step are taken separately for each signal to be transmitted to a terminal (MT1-MT4), and that in

said weighting step, at least two transmission signals are formed of the signal to be transmitted to each terminal (MT1-MT4).

15. (Previously Presented) The method according to claim 13, **characterized** in that at least some of said steps are taken substantially simultaneously for signals relating to different terminals (MT1-MT4).

16. (Previously Presented) The method according to claim 13, **characterized** in that at least some of said steps are taken consequtively for signals relating to different terminals (MT1-MT4).

17. (Previously Presented) The method according to claim 1, **characterized** in that in the method, the access point (AP1, AP2) uses an array of several antennas (ANT1, ANT2, ANTn) and having a variable directional pattern.

18. (Original) The method according to claim 17, **characterized** in that the antenna of the access point (AP1, AP2) used is an array of at least two antennas (ANT1, ANT2, ANTn), that signals are received at the access point (AP1, AP2) by the antennas (ANT1, ANT2, ANTn) of the array, and that signals transmitted by a terminal (MT1-MT4) and received via the antennas (ANT1, ANT2, ANTn) of the array are used in measurements.

19. (Previously Presented)The method according to claim 17, **characterized** in that information about the measured timing and frequency offsets as well as the spatial signature of the terminal (MT1-MT4) is stored at the access point (AP1, AP2), and that this information is used at least in the next data frame during the timeslots (702-707, 802-807) addressed to said terminal (MT1-MT4), to modify the directional pattern of the array of antennas and to perform time and frequency corrections.

20. (Previously Presented)The method according to claim 17, **characterized** in that the timing and frequency offsets of the terminal (MT1-MT4) are measured with at least two different antennas (ANT1, ANT2, ANTn), and that an average is formed of the timing and frequency offsets measured with the different antennas (ANT1, ANT2, ANTn).

21. (Previously Presented) The method according to claim 17, **characterized** in that at least said second conversion step is taken substantially simultaneously for signals relating to different antennas (ANT1, ANT2, ANTn).

22. (Previously Presented)The method according to claim 17, **characterized** in that at least said second conversion step is taken consecutively for signals relating to different antennas (ANT1, ANT2, ANTn).

23. (Previously Presented) The method according to claim 17, **characterized** in that in the method, for the remainder signal

$$r_n[k,p] = x_n[k,p] - H_n[k] \times d[k]$$

a position correlation matrix is determined

$$Q[k,p] = \bar{r}[k,p] \times \bar{r}[k,p]^H$$

in which $x_n[k,p]$ is the n^{th} signal received from the antenna (ANT1, ANT2, ANTn) in the frequency domain at a subcarrier frequency corresponding to the p^{th} teaching symbol transmitted by the terminal in a training sequence, $d[k]$ is

the training symbol at a subcarrier k, $H_n[k] = \left(\frac{1}{2}\sum_{p=1}^{2} x_n[k,p]\right) \times d[k]^*$

is one possible estimate for the frequency-domain radio channel calculated for the subcarrier k between the terminal and the antenna (ANT1, ANT2, ANTn) of the array of antennas of the base station,

$$\bar{r}[k,p] = (r_0[k,p], r_1[k,p], r_2[k,p], \mathrm{K}\ r_{N-1}[k,p])^T$$

the superscript H refers to complex conjugate transposition, the superscript * refers to complex conjugate, and the superscript T refers to transposition.

24. (Previously Presented) The method according to claim 17, **characterized** in that said measurements are taken during several timeslots to improve the accuracy of timing, frequency offset and channel estimates as well as to estimate time stability of the timing offset, frequency offset and channel properties, wherein the stability estimates are used to select the terminals (MT1-MT4) which are allocated simultaneous timeslots (702-707, 802-807).

25. (Currently Amended) Method according to claim 24, **characterized** comprising using ~~in that~~ said stability estimates in determining the frequency of future measurements ~~are used to estimate how often said measurements are taken~~.

26. (Original) The method according to claim 23, **characterized** in that in the method, at least the following steps are taken:

a first weighting coefficient vector $\overline{w}[k]=(H_0[k],H_1[k],H_2[k],\mathrm{K}\ ,H_{N-1}[k])^T$ is formed on the basis of the spatial signature,

said correlation matrix $(Q[k,p])$ is averaged over the frequency,

an inverse matrix is calculated for the averaged space correlation matrix,

said inverse matrix is averaged over the training symbols, and

a second weighting coefficient vector is formed by multiplying the first weighting coefficient vector with the averaged inverse matrix:

$$\overline{w}_{opt}[k] = \left\{ \frac{1}{P} \sum_{p=1}^{P} \left[\left(\frac{1}{K} \sum_{k=0}^{K-1} Q[k,p] \right) + \gamma \times I \right]^{-1} \right\} \times \overline{w}[k],$$

in which I is $N \times N$ unit matrix and γ is a certain small constant.

27. (Previously Presented) The method according to claim 1, **characterized** in that in the method, spatial filtering is performed in the time domain before estimation and correction of the timing and frequency offsets of the terminal (MT1-MT4), wherein the spatial signature of the terminal (MT1-MT4) is estimated on the basis time-domain signals corresponding to the different antenna elements, that the spatial signature is stored to be used in transmission and reception, and that the time and frequency offsets in the space filtered signal are estimated and corrected, and that the corrected signal is subjected to at least a conversion step to perform time-to-frequency conversion, a channel estimation step to perform and correct channel

estimation, and a decoding step to decode the corrected signal to find out the information transmitted from the terminal (MT1-MT4).

28. (Original) The method according to claim 27, **characterized** in that the estimation of the spatial signature is performed by a recursive least squares (RLS) algorithm, known as such.

29. (Original) The method according to claim 27, **characterized** in that the spatial signature of the time domain is calculated on the basis of channel estimates of the frequency domain.

30. (Previously Presented) The method according to claim 27, **characterized** in that the access point receives substantially simultaneously signals transmitted by at least two different terminals, wherein said spatial signatures stored in the memory are used in spatial filtering, and that said combination step, first correction step, first conversion step, first channel estimation step, and decoding step are separately performed for the signal of each terminal.

31. (Previously Presented)The method according to claim 27, **characterized** in that in data transmission from the access point to the terminal, the weighting of signals to be led to the antennas (ANT1, ANT2, ANTn) is performed at the access point (AP1, AP2) after the second conversion step in the time domain.

32. (Previously Presented) The method according to claim 1, **characterized** in that the position of timeslots to be used for estimation of terminals (MT1-MT4) to be served simultaneously is selected to be substantially the same as the position of simultaneous uplink and downlink timeslots to be allocated to these terminals (MT1-MT4) later on in the data frame (FR).

33. (Previously Presented) The method according to claim 1, **characterized** in that the data transmission capacity is maximized by minimizing the time used by the access point for serving only one terminal at a time.

34. (Original) The method according to claim 33, **characterized** in that in the time slot used for estimation, the terminal only transmits a training sequence or an empty packet.

35. (Previously Presented) The method according to claim 1, in which the terminals transmit information in packets, **characterized** in that the lengths of the packets transmitted by the terminals to be served simultaneously are set to be substantially equal.

36. (Original) The method according to claim 35, **characterized** in that to set the packet length, packets are split into smaller parts which are transmitted separately.

37. (Original) A communication system (1) comprising at least an access point (AP1, AP2) and terminals (MT1-MT4), means (8, 15) for data transmission between the terminals (MT1-MT4) and the access point (AP1, AP2), in which communication data transmission frames (FR) are arranged to be used, comprising at least uplink timeslots (UL) for data transmission from the terminals (MT1-MT4) to the access point (AP1, AP2), and downlink timeslots (DL) for data transmission from the access point (AP1, AP2) to the terminals (MT1-MT4) via a wireless communication channel (CH), and which communication system (1) comprises means (18) for allocating one or more timeslots (702-707, 802-807) of said frames to the terminals (MT1-MT4), **characterized** in that the communication system (1) also comprises:

means (18, 19) for allocated at least partly overlapping timeslots (704-707, 802-807) to at least two terminals (MT1-MT4) in at least part of said frames (FR),

means (ES) for determining the spatial signature of at least said two terminals (MT1-MT4),

means (RX) for taking measurements for estimating the timing and frequency offsets of the terminal (MT1-MT4) and the properties of the communication channel at least partly on the basis of the signal transmitted by the terminal (MT1) to the access point (AP1, AP2),

means (19) for selecting the terminals (MT1-MT4) which are allocated overlapping timeslots (702-707, 802-807), in which selection the results of said measurements are arranged to be used, and

means (18) for preventing transmission to the access point (AP1, AP2) by other terminals (MT2-MT4) communicating with the access point (AP1, AP2) during said measurements.

38. (Original) An access point (AP1, AP2) comprising means (15) for data transmission between terminals (MT1-MT4) and the access point (AP1, AP2) in a communication system (1), in which data transmission data transmission frames (FR) are arranged to be used, comprising at least uplink timeslots (UL) for data transmission from the terminals (MT1-MT4) to the access point (AP1, AP2), and downlink timeslots (DL) for data transmission from the access point (AP1, AP2) to the terminals (MT1-Mt4) via a wireless communication channel (CH), and which communication system (1) comprises means (18) for allocating one or more timeslots (702-707, 802-807) of said frames to the terminals (MT1-MT4), **characterized** in that the access point (AP1, AP2) also comprises:

means (18, 19) for allocated at least partly overlapping timeslots (704-707, 802-807) to at least two terminals (MT1-MT4) in at least part of said frames (FR),

means (ES) for determining the spatial signature of at least said two terminals (MT1-MT4),

means (RX) for taking measurements for estimating the timing and frequency offsets of the terminal (MT1-MT4) and the properties of the communication channel at least partly on

the basis of the signal transmitted by the terminal (MT1) to the access point (AP1, AP2),

means (19) for selecting the terminals (MT1-MT4) which are allocated overlapping timeslots (702-707, 802-807), in which selection the results of said measurements are arranged to be used, and

means (18) for preventing transmission to the access point (AP1, AP2) by other terminals (MT2-MT4) communicating with the access point (AP1, AP2) during said measurements.

39. (Original) The access point (AP1, AP2) according to claim 38, **characterized** in that the data transmission frames (FR) also apply a random access phase (RA), during which the terminal (MT1-MT4) can perform transmissions to the access point (AP1, AP2), that said access point comprises means (14) for storing signals transmitted in said random access phase (RA), and means (19) for using the stored signals to determine the spatial signature of the terminal (MT1-MT4).

40. (Previously Presented)The access point (AP1, AP2) according to claim 38, **characterized** in that the access point (AP1, AP2) comprises an array of several antennas (ANT1, ANT2, ANTn) and having a variable directional pattern.

41. (Original) The access point (AP1, AP2) according to claim 40, **characterized** in that the antenna of the access point (AP1, AP2) used is an array of at least two antennas (ANT1, ANT2,

ANTn); that the access point (AP1, AP2) comprises means for receiving signals with the antennas (ANT1, ANT2, ANTn) of the array, and means for using signals transmitted by the terminal (MT1-MT4) and received via the antennas (ANT1, ANT2, ANTn) of the array, in measurements.

42. (Previously Presented)The access point (AP1, AP2) according to claim 40, **characterized** in that it comprises means (14) for storing information on the timing and frequency offsets of the terminal (MT1-MT4), and means (19, ANT1, ANT2, ANTn) for changing the directional pattern of the antenna in at least the next data frame for the time of timeslots (702-707, 802-807) addressed to said terminal (MT1-MT4) on the basis of the spatial signature of said terminal (MT1-MT4).

43. (Previously Presented) The access point (AP1, AP2) according to claim 40, **characterized** in that it comprises means (ANT1, ANT2, ANTn, RX) for measuring the timing and frequency offsets of the terminal (MT1-MT4) with at least two different antennas, and means (19) for forming an average of the timing and frequency offsets measured with the different antennas.

44. (Previously Presented)The access point (AP1, AP2) according to claim 40, **characterized** in that the means (ANT1, ANT2, ANTn, RX) for measuring the timing and frequency offsets of the terminal (MT1-MT4) comprise at least:

receiving means (RF1, RF2, RFn) for receiving signals transmitted by the terminal with at least two different antennas,

correction means (E1, E2, En) for correcting the received signals on the basis of the measured time and frequency offsets,

first conversion means (FFT1, FFT2, FFTn) for performing a time-to-frequency conversion on the corrected signals,

channel estimation means (w1, w2, wn) for performing channel estimation on the signals converted to the frequency domain,

combining means (C) for combining the filtered signals, and

decoding means (DEC) for decoding the combined signal to determine the information transmitted from the terminal (MT1-MT4).

45. (Original) The access point (AP1, AP2) according to claim 44, **characterized** in that it also comprises channel correction means (EQ) for correcting the combined signal on the basis of the properties of the communication channel estimated from the combined channel.

46. (Previously Presented) The access point according to claim 44, **characterized** in that it comprises means for receiving signals transmitted by two different terminals substantially simultaneously, wherein the access point (AP1, AP2) comprises said correction means, first conversion means (FFT1, FFT2, FFTn), combining means (C) and decoding means (DEC) for processing the signal of each terminal separately.

47. (Previously Presented) The access point (AP1, AP2) according to claim 40, **characterized** in that in data transmission from the access point (AP1, AP2) to the terminal (MT1-MT4), at least the following steps are taken:

encoding means (M) for encoding the signal to be transmitted,

weighting means (W) for forming at least two transmission signals from the signal to be transmitted,

second conversion means (IFFT1, IFFT2, IFFTn) for performing a frequency-to-time conversion on said at least two transmission signals, and

transmission means (RF1, RF2, RFn) for transmitting the transmission signals converted to the time domain.

48. (Original) The access point (AP1, AP2) according to claim 47, **characterized** in that it comprises means (TX) for transmitting signals to at least two different terminals substantially simultaneously, wherein the access point (AP1, AP2) comprises said encoding means (M) and weighting means (W) for processing the signals to be transmitted to each terminal substantially simultaneously.